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Summary Report on the 2012 Sun Grant National Conference: Science for Biomass Feedstock Production and Utilization

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Abstract The *2012 Sun Grant National Conference on Science for Biomass Feedstock Production and Utilization* was held on 2–5 October 2012, in New Orleans, LA, USA. The Sun Grant Initiative set out to highlight recent advances in science and technology contributing to the deployment of conventional and advanced biofuels and bioproducts from agricultural and forest systems. The Initiative, with sponsorship from the Department of Energy's Bioenergy Technologies Office (BETO), assembled an agenda focusing on promoting collaboration between academic, industry, non-profit, and government partners. This special issue is comprised of a small sample of conference presentations selected to reflect important research progress and to highlight the range of issues that must be considered as the transition to biomass energy takes hold.

Keywords Sun Grant · Regional feedstock partnership · Biomass · Bioenergy · Bioproducts

A key function of the Sun Grant Initiative is to showcase the regionally focused research targeting biomass and bioenergy-related topics, and to provide a forum for the broader research community to discuss progress, consider broader research needs, and explore opportunities for collaboration. The *2012 National Conference on Science for Biomass Feedstock Production and Utilization*, held in New Orleans, LA, was structured to capture the current state of the science related to the different unit operations of the biofuels supply chain. This organization allowed developments in crop production, conversion technologies, sustainability considerations, preprocessing, logistics, and policy to be presented from different perspectives and common points. The plenary and general sessions highlighted recent advances in science and technology impacting the deployment of conventional and advanced biofuels, bioproducts, and biomaterials, and addressing the overarching conference theme of expanding the bioeconomy through targeted research, development and demonstration. This special issue summarizes research presented at the conference, and highlights 12 articles and corresponding projects expanding the bioeconomy through targeted research, development, and demonstration. The Sun Grant Initiative would like to thank the authors for their contributions and dedication to this special issue.

More than 120 presentations on a wide array of topics (Table 1) were provided in the parallel sessions and the poster session at the conference. This response from the research community lends clear evidence of the commitment to address the national priority of reduced dependence on petroleum. It also highlights the progress that has been made in resolving many of the challenges presented by the need for alternative liquid fuels from biomass. The entire collection of presentation material and the complete proceedings of the conference is available for download from the conference website (www.sungrant.tennessee.edu/NatConference/). Additionally, a number of presenters were invited to contribute manuscripts to two special issues of *BioEnergy Research*.

The first special issue, *Crop Residue Considerations for Sustainable Bioenergy Feedstock Supplies*, addressed developments around agricultural residue as feedstock for cellulosic ethanol production [1]. The collection of papers included reports on cereal residue and corn stover and highlighted

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Table 1 Summary of general sessions by topic, number of papers, and subject area

Session topic	Number of papers	Subject areas
Energy crop development	14	Breeding, genetics, genomics, yield
Biomass production	36	Inputs, soils, nitrogen management
Biomass logistics	14	Assessment, harvest, storage, densification, costs
Feedstock conversion	18	Processes, products
Biomass characterization	7	Composition, methods, energy
System sustainability	14	Soil quality, residues, LCA, GHG
Model and metrics	11	Siting, supply, production
System case studies	5	Regional studies
Extension and education	4	Curriculum, dissemination
Total	123	

important progress in defining new metrics for sustainable levels of removal in these systems. The work also highlighted research products from the Regional Feedstock Partnership (RFP) established between the Department of Energy's Bioenergy Technologies Office (BETO) and the Sun Grant Initiative (www.sungrant.org). To address the need of readily accessible, sustainable feedstocks in the USA, the BETO, and the Sun Grant Initiative formed the RFP. The Partnership is halfway through a 7-year project that has included establishing over 100 field trials as well as crop modeling projects. In addition, educational and outreach work is under way to help agricultural producers, industry, and other stakeholders prepare for a future that could include processing biomass crops for energy and other products.

In this second special issue to appear in *BioEnergy Research*, attention is shifted to broader concerns and advanced fuel production systems. Four distinct topic areas are discussed that reflect the evolution of thinking and the emerging vision of tomorrow's biorefinery. Specifically, these contributions provide new information on production and yield of high-impact energy crops, progress in the many challenges of biomass logistics, innovative directions in feedstock conversion processes, and insight into social acceptance concerns.

Topic Area 1: Biomass production and yield continue to be the drivers for supply. In this topic area, five articles address recent progress in biomass production across the USA. Trends in these articles suggest the need to consider feedstock quality in addition to feedstock quantity. Incorporated in this section are articles on four specific biomass feedstocks: switchgrass, big bluestem, short rotation woody crops (SRWC) and sorghum. Pacaldo, et al. [6] assessed the use of SRWC for bioenergy production and the soil CO_2 emission rates related to the continuous production and tear-out treatments. Soil CO_2 efflux (Fc) rates among SRWC fields in production for 7 to 21 years were measured and recorded. Results indicate that Fc rates were consistent across the different ages. Pacaldo, et al. [6] concluded that soil temperature significantly influenced CO_2 flux, while soil moisture had no impact.

Hong, et al. [13] and Wagle and Kakani [2] summarized some of the work on switchgrass, one of the primary feedstocks of the RFP. Hong, et al. [13], with funding from the RFP, established replicated plots in NY, OK, SD, and VA in 2008 and in IA in 2009. Nitrogen (N) fertilizer (0, 56, and 112 kg N ha^{-1}) was applied each spring after the seeding year. Over several location/year combinations, switchgrass production ranged from 2 to 11.5 Mg ha^{-1}. Hong, et al. [13] indicated that with consistent and accurate N management, producers could reduce expenses and potential negative environmental impacts. Wagle and Kakani [2] evaluated the relationship of ecosystem respiration to environmental factors, specifically, soil temperature and moisture in switchgrass. The authors analyzed ecosystem respiration from the nighttime net ecosystem CO_2 exchange measurements. Results suggest that soil moisture significantly influences the correlation between soil temperature and ecosystem respiration.

Similarly, Zhang et al. [4] evaluated the effects of ecotype and planting location on the chemical (glucan, xylan, arabinan, lignin, and ash) and elemental (carbon, oxygen, hydrogen, nitrogen, and sulphur) composition of big bluestem in the Midwest. The authors found that ecotype had effects on both chemical and elemental compositions, and the ecotype–location combination had significant effects on glucan, lignin, and hydrogen. Zhang et al. [4] concluded that planting location had a greater effect on chemical and elemental compositions, suggesting that big bluestem would be suitable for the Midwest.

Topic area 1 concludes with an assessment on sorghum biomass, and the compositional changes and biomass growth patterns over an entire growing season in College Station and Corpus Christi, TX. Hoffman and Rooney [7] reported on these field trials, which had 13 total harvest dates with yield, height, and biomass composition measured at each harvest. Lignin content and cellulose was also analyzed at plant maturity. Results from Hoffman and Rooney [7] suggest that maximum sorghum biomass accumulation occurs between 140 and 200 days and depends on the genotype selected. The top genotype in this trial produced a dry biomass yield of 24 Mg ha^{-1}.

Topic Area 2: Transportation, storage, and the delivery of a consistent and uniform feedstock to the biorefinery are all key challenges of the biofuels industry and discussed in this topic area. In this topic area, four articles examine several biomass logistics systems. Greene et al. [8] compared the costs of several woody biomass–harvesting systems including whole-tree chipping, clean chipping, conventional roundwood and residue grinding by evaluating ash content, moisture content, and a range of other factors. Evaluations indicate that whole tree chipping provided a low cost option at less than 1 % ash. Unscreened grinding of clean chip residue produced the least expensive option and 5 % ash. Factors significantly effecting delivered costs are truck payload, fuel price, and haul distance among others. Searcy et al. [9] examined a biomass logistics system with features similar to cotton and silage shipping systems. The evaluation included a full-scale system and field trials of the biomass modules with sorghum, switchgrass, and corn stover. Results suggest that with modified equipment biomass modules can be formed (of up to 5.2 Mg), stored for 3–12 months, loaded and transported for long distances with no significant degradation.

The effect of lime pretreatment on the production of switchgrass granules was investigated using a new wet granulation technology. Yandapalli and Mani [10] determined that granules made from 20 % lime had significantly higher density; however, treated granules also had significantly higher ash content and lower gross calorific value. Yandapalli and Mani [10] determined that lime treatment was not beneficial for thermochemical conversion, but treated granules could be used in the production of biofuels and bio-based chemicals through the biochemical conversion platform.

As Hoffman and Rooney [7] indicated, biomass sorghum shows promise as a bioenergy feedstock. To address the issues of high moisture content and high levels of degradation, Bonner, et al. [11] allowed harvested sorghum material to dry under in-field conditions, and examined the differences in drying rates of intact and conditioned sorghum. Results indicate that conditioning accelerates drying time. The authors conclude that the process of conditioning sorghum to accelerate drying is beneficial, and justifies the expense of additional handling.

Topic Area 3: Only two conversion technology related articles are included in this special issue. However, both are intended to highlight new approaches to feedstock quality, while targeting drop-in fuel production. Bozell, et al. [12] examined two features of the integrated biorefinery concept: (1) biomass fractionation into separate process streams and (2) the conversion of those streams into bio-based chemical products. The high value chemical production output could provide additional financial support for biofuel production at the biorefinery. Bozell, et al. [12] concludes that this integration would play a critical role in success of the biofuels industry. Through this research, Bozell, et al. [12] also found that the organosolv fractionation of biomass could produce high value and high quality lignin.

Srinivasan, et al. [5] examined the pretreatment process of torrefaction for improving the quality and stability of pyrolysis liquid (bio-oil) produced from catalytic fast pyrolysis. Fast pyrolysis produces a higher liquid yield; however, bio-oil can be unstable, immiscible with other hydrocarbon fuels and have restrictive use as a biofuel. During torrefaction, there is a reduction in oxygen content and an increase in the calorific value of the biomass. The authors combined torrefaction with fast pyrolysis processes to produce high quality bio-oil, which resulted in a stable liquid fuel product.

Topic Area 4: Despite the importance of social acceptance and societal issues, this topic area is inadequately represented. In this special issue, one article, Bergtold, et al. [3] assesses farmers' willingness to produce bioenergy crops. Enumerated field surveys were given to farmers with stated choice experiments designed to elicit their willingness to produce corn stover, sorghum, and switchgrass under a variety of contractual arrangements. Using a random utility framework, the authors examined the contractual components that increased farmer adoption. Bergtold et al. [3] concludes that net returns, contract length, cost–share, financial incentives, insurance, and custom harvest options are all valuable attributes to farmers, and should be considered in the emerging biofuels industry.

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References

1. Karlen D, et al. (Eds.) (2014) Crop residue considerations for sustainable bioenergy feedstock supplies. [Special Issue]. BioEnergy Res (7):465–764.
2. Wagle P, Kakani VG (2014) Confounding effects of soil moisture on the relationship between ecosystem respiration and soil temperature in switchgrass. BioEnergy Res 7(3). doi:10.1007/s12155-014-9434-8
3. Bergtold JS, Fewell J, Williams, J (2014) Farmers' willingness to produce alternative cellulosic biofuel feedstocks under contract in Kansas using stated choice experiments. BioEnergy Res 7(3). doi:10.1007/s12155-014-9425-9
4. Zhang K, Johnson L, Yuan W, Pei Z, Chang SI, Wang D (2014) Glucan yield from enzymatic hydrolysis of big bluestem as affected by ecotype and planting location along the precipitation gradient of the Great Plains. BioEnergy Res 7(3). doi:10.1007/s12155-014-9477-x
5. Srinivasan V, Adhikari S, Chattanathan SA, Tu M, Park S (2014) Catalytic pyrolysis of raw and thermally treated cellulose using different acidic zeolites. BioEnergy Res 7(3). doi:10.1007/s12155-014-9426-8
6. Pacaldo RS, Volk TA, Briggs RD (2014) Carbon sequestration in fine roots and foliage biomass offsets soil CO2 effluxes along a 19-year chronosequence of shrub willow (*Salix x dasyclados*) Biomass Crops. BioEnergy Res 7(3). doi:10.1007/s12155-014-9416-x
7. Hoffman L Jr, Rooney W (2014) Accumulation of biomass and compositional change over the growth season for six photoperiod sorghum lines. BioEnergy Res 7(3). doi:10.1007/s12155-013-9405-5
8. Greene WD, Cutshall JB, Dukes CC, Baker SA (2014) Improving woody biomass feedstock logistics by reducing ash and moisture content. BioEnergy Res 7(3). doi:10.1007/s12155-013-9404-6
9. Searcy SW, Hartley BE, Thomasson JA (2014) Evaluation of a modular system for low cost transport and storage of herbaceous biomass. BioEnergy Res 7(3). doi:10.1007/s12155-014-9427-7
10. Yandapalli V, Mani S (2014) Effect of lime pretreatment on granulation of switchgrass. BioEnergy Res 7(3). doi:10.1007/s12155-014-9443-7
11. Bonner IJ, Smith WA, Einerson JJ, Kenney KL (2014) Impact of harvest equipment on ash variability of baled corn stover biomass for bioenergy. BioEnergy Res 7(3). doi:10.1007/s12155-014-9432-x
12. Bozell JJ, Astner A, Baker D, Biannic B, Cedeno D, Elder T, Hosseinaei O et al. (2014) Integrating separation and conversion – conversion of biorefinery process streams to biobased chemicals and fuels. BioEnergy Res 7(3). doi:10.1007/s12155-014-9424-x
13. Hong CO, Owens VN, Bransby D, Farris R, Fike J, Heaton E, Kim S, Mayton H, Mitchell R, Viands D (2014) Switchgrass response to nitrogen fertilizer across diverse environments in the USA: a regional feedstock partnership report. BioEnergy Res 7(3). doi:10.1007/s12155-014-9484-y